CASE STUDY 14: EFFECTIVE UTILIZATION OF RED MUD AS ALTERNATE RAW MATERIAL - DALMIA CEMENT (BHARAT) LIMITED

Project Implemented by : Dalmia Cement (Bharat) Limited

Project Implemented in : 2009

Company Details

Dalmia Cement (Bharat) Limited founded in 1935 by Jaidayal Dalmia. The cement division of DCBL was established in 1939 and enjoys a heritage of 70 years of expertise and experience. The Company is headquartered in New Delhi with cement, sugar, travel agency, magnesite, refractory and electronic operations spread across the country.

The Dalmia Group had established four cement plants in pre-independence years, two of which were affected by the partition and Independence. The two remaining plants operate as Dalmia Cement and we have also made strategic investment in Orissa Cements Limited (OCL). It is Managed by a professional team, have sustained the path to innovation and growth for seven decades.

Project Details

Limestone, bauxite and Iron ore are used to manufacture clinker. Cost of Additive (Bauxite) is high resulting high cost of clinker production. Plant team explored feasibility for using industrial waste to compensate costly additives preferably to suit high sulphur fuel.

Dalmia team identified Red Mud as alternative Raw material which contains rich alkali which will subside the impacts of excess sulphur. Red Mud is an industrial waste from Malco, an Aluminium manufacturing unit contains 7 % of alkalies which has the great potential to balance the excess SO_3 that enters the system through LS and High sulphur fuel.

New raw mix with red mud and high sulphur fuel was so designed that Bauxite use was totally eliminated. Following benefits are associated with the help of red mud at Dalmia cement.

- Raw mix cost is reduced by Rs 10/MT, since the Red mud cost is half that of bauxite
- The silica of the Red mud was lower than that of LS, and eliminating the high silica bauxite was desirable for Limestone used at the plant

- Red Mud could increase the alkali content by 0.28% in raw mix
- The Titania contained in the Bauxite was supposed to produce clinker with less hydraulic properties and thus resulting in long setting cement. By eliminating the usage of bauxite, the Titania intake to the clinker is reduced and the opportunity to produce high hydraulic clinker opened up

The clinker produced before the trial, during red-mud trial and during the red mud /pet coke combo trials were collected and tested in the laboratory for the product characteristics.

The hydraulic property of the clinker has improved drastically. The 1Day strength has increased by 4MPa, the 3 day strength by 11 MPa, and the 7day strength by 6MPa i.e., the elevation of strength was in the range of 18%, 25% and 11% for 1day, 3days and 7days respectively.

This improvement in hydraulic properties is achieved because of the alkali sulphates formed by the combination of SO_3 in Pet coke/LS with Na_2O contained in red mud. These alkali sulphates have a unique property to accelerate the hydration of di-silicates and tri-silicates of cement to gear up the overall strength of resultant cement.

These minor constituents when present in clinker, can activate the pozzolanic properties of fly ash or hydraulic properties of slag, giving the freedom to increase their percentage in cement. The increased amount of Portlandite generated in the hydration of C_3S will be available for pozzolanic activity at an earlier age itself to give high early strength, a very desirable property of PPC.

Parameter	Blank before trial	Trial with Red mud	Trial with red mud/Pet-coke combo
SiO_2, %	21.91	21.90	21.89
Al_2O_3, %	5.12	5.08	5.04
Fe_2O_3, %	4.82	4.62	4.79
CaO, %	65.31	64.99	65.03
MgO, %	1.08	1.07	1.07
SO_3, %	0.43	0.62	0.72
Na_2O, %	0.41	0.58	0.62
K_2O, %	0.2	0.42	0.38
F.CaO, %	1.52	1.53	1.50
LSF	0.92	0.92	0.92
SM	2.20	2.26	2.23
AM	1.06	1.10	1.05
C3S	50.60	49.35	49.45
C2S	24.65	25.57	25.46
C3A	5.41	5.65	5.25
C4AF	14.67	14.06	14.58
Liquid, %	28.04	28.05	28.41

Red Mud/Pet coke Trials

Parameter	Blank before trial	Trial with Red mud	Trial with red mud/Pet-coke combo
1 Day, MPa	22.10	24.00	26.00
3 Days, MPa	43.90	50.70	55.00
7 Days, MPa	55.00	60.00	61.70
28 Days, MPa	70.50	68.00	64.00

The excellence is also exhibited in the production of green products at Kadapa unit of Dalmia Cement, because huge quantity of red mud an industrial waste, alkaline in nature which does not support growth of vegetation and that which might make the area of storage and around barren, is productively eliminated.

The micro-fine particles, which might fly in the air around the storage area and can cause serious bronchus & skin problems to human beings and animals is very productively accommodated in our raw meal with comparatively lower raw grinding energy and cost. The usage of this waste in our process instead of bauxite saves the latter from getting depleted and conserves it for future generation.

The pollutant waste is fine in nature and hence the raw grinding energy has to come down at least by 4%. The alkali contained in the Red mud is established as the best flux, modify the viscosity of the melt favorably and saves heat energy at least by 5 kCal/kg of clinker.

Since the alkali sulphates can activate the pozzolana and since the hydraulic property of the clinker is superior, we can elevate the cement clinker ratio and reduce the carbon factor/MT of cement.

Red Mud in Stockyard

Issues faced during the implementation of the project

- High Moisture presence in the material causes jamming of Hoppers and weigh feeder chutes which were addressed by using Air Blasters
- Initially unloading problem occurred at truck tippler due to high moisture
- Requested the supplier to load sun dry material and problem was solved

Financing of the Project

Using of Red Mud will result in annual savings of Rs 3.00 Crores annum

Results of the Project

- Large quantity of waste of Malco was used in our cement process as an alternative raw material
- Avoided usage of 100 % Bauxite
- Red mud is in fine in nature which reduces our raw mill power consumption and increases the liquid content in kiln results in saving of heat energy 5 kCal/ kg of clinker

Replication Potential

Similar project can be implemented in all cement plants in India

Recommendation to other units

It is recommended to use Red mud as alternative raw material instead of Bauxite.

Contact Information of the plant

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